510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY AND INSTRUMENT COMBINATION TEMPLATE

A. 510(k) Number:

k053312

B. Purpose for Submission:

Clearance to market a hand-held glucose meter for over-the-counter use**.**

C. Measurand:

Glucose

D. Type of Test:

Quantitative, over-the-counter determination of glucose in whole blood.

E. Applicant:

Bioptik Technology, Inc.

F. Proprietary and Established Names:

EasyMate Blood Glucose Monitoring System

G. Regulatory Information:

1. Regulation section:

   21 CFR §862.1345, Glucose test system.

2. Classification:

   Class II

3. Product code:

   NBW: blood glucose test system, over the counter
   CGA: glucose oxidase, glucose

4. Panel:

Clinical Chemistry (75)

H. Intended Use:

1. Intended use(s):

   Please see indications for use (below).

2. Indication(s) for use:

   The self-testing EasyMate Blood Glucose Monitoring System is indicated for use by healthcare professionals and persons with diabetes to measure glucose values in capillary, finger stick whole blood. Frequent monitoring of whole blood glucose is an adjunct to the care of persons with diabetes.

3. Special conditions for use statement(s):

   For use with capillary blood sampled from fingertips (fingerstick) only. This product is intended for over-the-counter use.

4. Special instrument requirements:

   EasyMate Blood Glucose Monitoring System

I. Device Description:

The EasyMate Blood Glucose Monitoring System is an electrochemical biosensor consisting of a glucose-oxidizing enzyme on a disposable test strip (the electrochemical sensor) and a hand-held current measuring device. Software internal to the hand-held device converts the measured current into glucose concentration using an algorithm that depends on the ambient temperature and the activity of the enzyme on the test strip. Variations in enzyme activity on the strip and other lot-specific calibration information are supplied to the device by a small chip that accompanies each vial of strips. Users can validate the operation of the system by using glucose control solutions provided with the system.

The devices used well established biochemical, electrical, and software methodologies. No new or unproven techniques are introduced with this device.

The EasyMate Blood Glucose Monitoring System comprises a glucose reagent test strip, a handheld meter, a quality control solution, and an owner's booklet. A lancing device, lancets, a quick reference guide for performing the test, a logbook for recording test results, and a carry case are also included with the system.

The EasyMate Blood Glucose Monitoring System can measure glucose concentrations ranging from 20 to 600 mg/dL in whole capillary blood with hematocrits ranging from 30-55%

J. Substantial Equivalence Information:

1. Predicate device name(s):

   Precision XTRA Advanced Diabetes Management System

2. Predicate 510(k) number(s):

   k983504

3. Comparison with predicate:

Similarities		
Item	Device	Predicate
Analyte	Glucose	Glucose
Measurement Method	Electrochemical	Electrochemical
Tested material	Whole Blood	Whole Blood
Enzyme	Glucose Oxidase (Aspergillus niger)	Glucose Oxidase (Aspergillus niger)

Differences		
Item	Device	Predicate
Measurement Time	25 seconds	20 seconds
Temperature Range	57.2 °F – 104 °F	50 °F – 104 °F
Sample Volume	4 µL	5 µL
Maximum Altitude for measurement	8000 feet above sea level	7200 feet above sea level

K. Standard/Guidance Document Referenced (if applicable):

FDA Guidance: "Guidance for Industry In Vitro Diagnostic Glucose Test System"

ISO 15197: In vitro diagnostic test systems - Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus

CLSI EP05-A2: "Evaluation of Precision Performance of Clinical Chemistry Devices; Approved Guideline-Second Edition"

CLSI EP06-A: "Evaluation of the Linearity of Quantitative Analytical Methods; Approved Guideline"

CLSI EP07-A2: "Interference Testing in Clinical Chemistry; Approved Guideline- Second Edition"

CLSI EP09-A2: "Method Comparison and Bias Estimation Using Patient Samples; Approved Guideline - Second Edition"

L. Test Principle:

The test is based on the release of electrical potential after a two-step reaction where glucose and ferricyanide, in the presence of glucose oxidase, are converted into gluconolactone and ferrocyanide. The reduced ferrocyanide complex releases electrons at the strip electrode. The current generated by this oxidation is proportional to the glucose concentration.

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. Precision/Reproducibility:

The company followed CLSI EP05-A2: "Evaluation of Precision Performance of Clinical Chemistry Devices; Approved Guideline-Second Edition" in verifying the precision of their device. The company assessed the precision of the blood glucose system by making repeated measurements at 5 different glucose concentrations. The study was performed using depleted venous whole blood samples adjusted to five different levels of glucose concentrations. The company performed 10 replicate measurements at each glucose concentration on each of 10 different hand-held meters. In addition, the company repeated this test suite across 3 different lots of strips for a total of 1500 measurements. A YSI 2300 glucose analyzer was used as a reference standard. The YSI was calibrated using a YSI Standard Calibration solution per manufacturers' instructions prior to measurement on each lot of strips.

The following table summarizes the observed performance of the meter:

Glucose Concentration (mg/dL)	Average [glucose], mg/dL	Average Std. Dev. (mg/dL)	Maximum %CV (across lots)
34	41.8	2.9	9.2
98.4	86.8	3.9	4.5
132	114.1	4.9	4.2
230.7	207.6	8.6	3.8
366	354.7	12.9	5.2

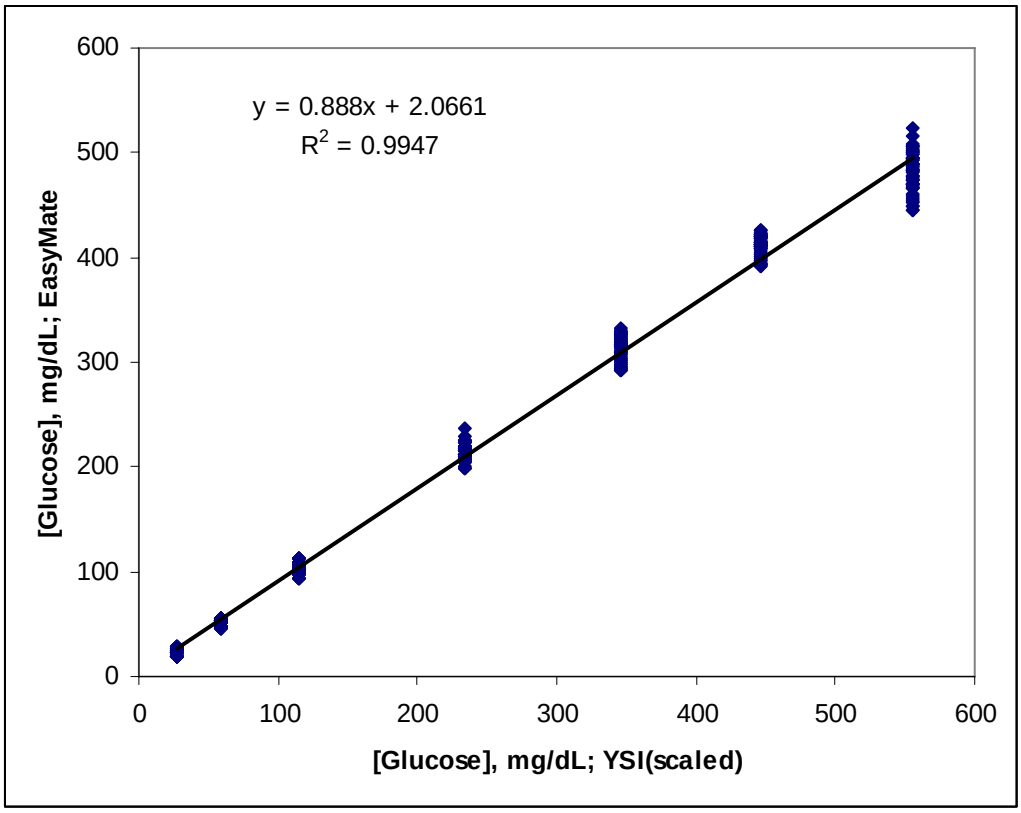
The meter conformed to ISO 15197 performance requirements.

b. Linearity/assay reportable range:

The company referenced CLSI EP06-A: "Evaluation of the Linearity of Quantitative Analytical Methods; Approved Guideline" and ISO 15197: "In vitro diagnostic test systems - Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus" in assessing the linearity of their device. The company made 10 replicate measurements at 10 glucose concentrations spanning the range of their device using 10 different meters.

The following graph illustrates the linear relationship between the proposed device

and a YSI glucose meter over the 20-600 mg/dL range claimed for the device:



While fitting a higher order polynomial to the data did improve the fit slightly, this improvement was not statistically significant.

At the highest concentration tested within the meter's range, the mean of the measured points was greater than 1.96 standard deviations above the ISO 15197 lower limit of -20%. None of the measured points fell below -20% limit of ISO 15197.

c. *Traceability, Stability, Expected values (controls, calibrators, or methods):*

The company assessed the stability of their strips using real-time aging studies. The company tested 3 lots of measurement strips. The data provided by the company supports their claim of an unopened shelf life of 2 years.

The company substantiated their opened "In-Use" stability claim using real-time aging studies. The information supplied by the company supports their claim of a 3 months opened shelf life if the strip vial is capped immediately after removing a strip.

In addition, the company supplied data on transport stability studies demonstrating that their strips gave accurate measurements after storage at 65 °C or -20 °C for one week. However, the company recommends the strips be shipped at room

temperature.

Control solutions are manufactured gravimetrically and concentrations are confirmed via measurement with YSI calibrated with calibrators traceable to Yellow Springs Instruments.

The company assessed the stability of their 2 levels of control solutions using real-time aging studies. The company tested 3 lots of control solutions. The data provided by the company supports their claim of an unopened shelf life of 1 year.

The company substantiated their opened "In-Use" stability claim using real-time testing. The data supplied by the company supports their claim of a 3 month opened shelf life if the control is capped immediately after use.

In addition, the company supplied data on transport stabilities study demonstrating that their control solutions gave accurate measurements after storage at 65 °C for one week. However, the company recommends that the solutions be shipped at room temperature.

d. Detection limit:

The EasyMate meter assigns a non-numeric "LO" symbol for glucose measurements falling below 20 mg/dL. The EasyMate meter assigns a non-numeric "HI" symbol for glucose measurements falling above 600 mg/dL.

The company made 60 replicate measurements on glucose depleted blood with a scaled YSI value of 16.5 mg/dL. They demonstrated that their device gave 17 readings, or 28.3%, of 20 mg/dL. The remaining 43 measurements, or 71.2%, gave a non-numeric "LO" value. All numeric measurements fell within the +/- 15 mg/dL range specified in ISO 15197.

The company made 60 replicate measurements on glucose depleted blood with a scaled YSI value of 27.2 mg/dL. The company demonstrated that their device gave 60 numeric readings, or 100%, numeric. At this concentration, the 44 of 60 measurements were within 2 standard deviations of the scaled YSI measurement. All measurements fell within the +/- 15 mg/dL range specified in ISO 15197.

The company made 60 replicate measurements on glucose enriched blood with a scaled YSI value of 657 mg/dL. The company demonstrated that their device gave 3 or 5% non-numeric "HI" readings. 100% of the remaining 57 measurements yielded number results that fell above the -20% limit specified in ISO 15197.

The company challenged their upper limit with 60 replicate measurements on glucose enriched blood with a scaled YSI value of 731 mg/dL. Numeric values ranging from 585 mg/dL to 600 mg/dL, the limit of the meter, would have met ISO 15197 criteria. The company's device consistently yielded a "HI" reading, i.e. over 600 mg/dL, for

100% of the points measured.

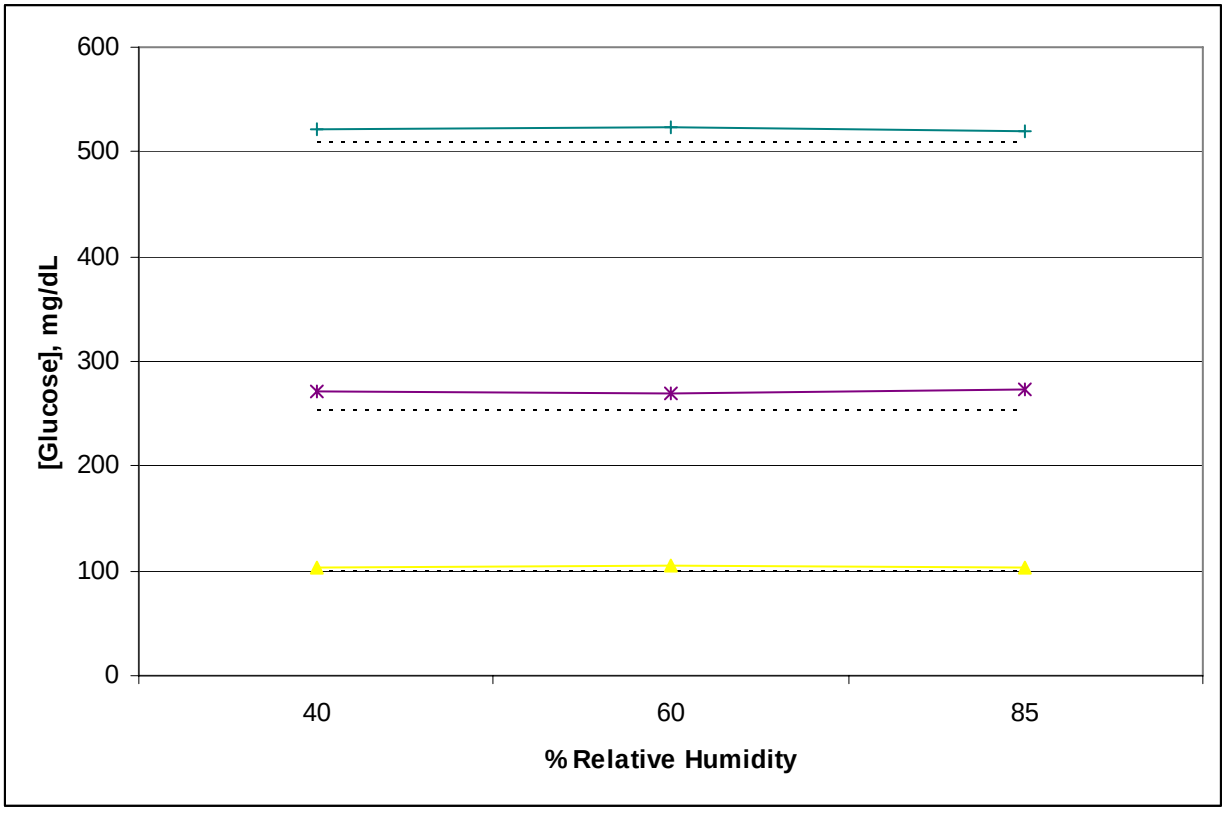
e. Analytical specificity:

Interference testing was conducted to determine the effect of select endogenous and exogenous substances.

Humidity

The company assessed the impact of relative humidity on their device by measuring 3 different concentrations of blood glucose across a range of humidities. Each measurement was repeated ten times on each of 3 meters. The relative humidity at 24 °C was varied from 40% to 85%, the range claimed for this device.

The following graph illustrates the impact of humidity on measurements using the EasyMate. The dotted lines denote scaled glucose concentrations as determined by a YSI.



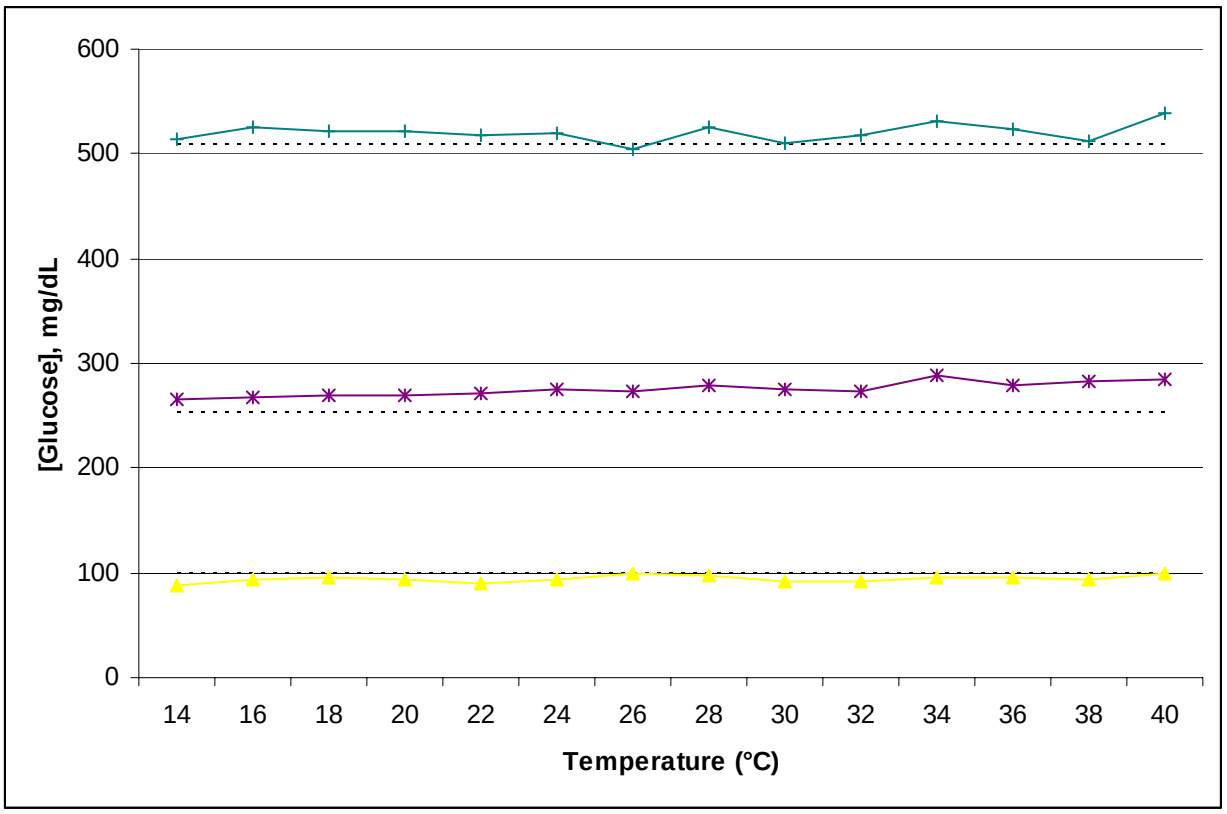
The company also assessed the impact of humidity on measurements of their glucose control solutions. The company measured two different glucose concentrations, 102 and 304 mg/dL. Each measurement was repeated ten times for each of 3 meters.

There was no effect of humidity from 40% to 85% on the measured value of the control solutions,

Temperature

The company assessed the impact of temperature on their device by measuring 3 different concentrations of blood glucose across the temperature range claimed for the device. The company measured three different glucose concentrations. Each measurement was repeated ten times for each of 3 meters.

The following graph illustrates the impact of temperature on measurements using the EasyMate. The dotted lines denote scaled glucose concentrations as determined by a YSI.



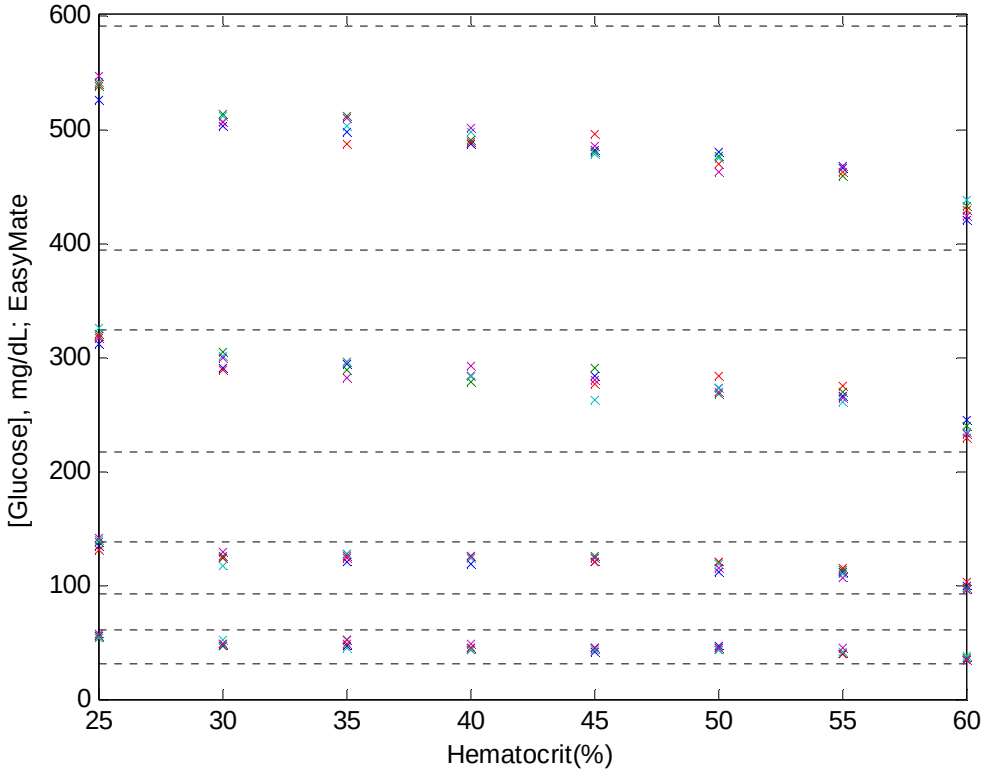
The company also quantified the impact of temperature on measurements of their glucose control solutions. The company measured two different glucose concentrations, 102 and 304 mg/dL. Each measurement was repeated ten times for each of 3 meters. There was no effect of temperature on the measured value of the control solutions,

Hematocrit

The company studied the impact of varying hematocrit by testing blood samples with

hematocrits from 25% to 60% using four different glucose concentrations spanning the range of the meter. The hematocrit of pooled blood was adjusted by centrifugation and dilution with serum. Glucose levels were adjusted by spiking. The company made 10 measurements at each glucose concentration across 5 meters and 5 lots of strips. Glucose concentrations were confirmed via measurement with YSI.

The following graph illustrates the impact of Hematocrit on measurements using the EasyMate. The dotted lines denote acceptance ranges per ISO 15197.



The data provided by the company supports their claimed Hematocrit range of 30%-55%.

Altitude

The company evaluated their performance both at sea level and at an elevation of 8125 feet. They quantified their performance by making 20 replicate measurements on normal and high control solutions. Twenty measurements were determined using the EasyMate monitoring system and the control solutions (normal and high). Measurements were made according to the instructions contained in the user manual.

The results of this study:

Glucose Concentration	Measured [Glucose], mg/dL (948 feet elevation)	Measured [Glucose], mg/dL (8125 feet elevation)
100 mg/dL	109.8 ± 5.8	109.2 ± 5.1
300 mg/dL	329.8 ± 9.1 mg/dL	329.7 ± 6.2 mg/dL

The data provided by the company supports their claim for a maximum operating altitude of 8000 feet.

Interference

The company followed CLSI EP07-A2: "Interference Testing in Clinical Chemistry; Approved Guideline- Second Edition" and CLSI EP09-A2: "Method Comparison and Bias Estimation Using Patient Samples; Approved" in determining the impact of common blood analytes on their device.

The company made 20 replicate measurement of pooled blood spiked with a potential interferant at each of 5 different glucose concentrations spanning the measurement range of the device for each of 10 meters. The company made 20 replicated measurements on unmodified material for each of 10 meters for comparison.

Analyte	Highest concentration without interference (in mg/dL)
Acetaminophen	10
L-Dopa	-
Tolbutamide	5
Dopamine	-
Ibuprofen	20
Salicylic acid	50
Methyl-Dopa	5
Tetracycline	1
Glibenclamide	0.1
Ketoprofen	5
Diclofenac	4
Indomethacin	8
Amiloride	0.8
Colchicine	0.25
Atenolol	4

Analyte	Highest concentration without interference (in mg/dL)
Ascorbic acid	3
Creatinine	5
Uric acid	10
Cholesterol	500
Bilirubin	1.85
Triglyceride	360

L-Dopa was found to give a 20 mg/dL increase in measured glucose concentration at the lowest concentration tested, 1.25 mg/dL. Dopamine at 3 mg/dL was found to introduce a 50 mg/dL increase in measured glucose concentrations. In their product literature, the company warns users about the using this device while being treated by these therapeutic agents.

f. Assay cut-off:

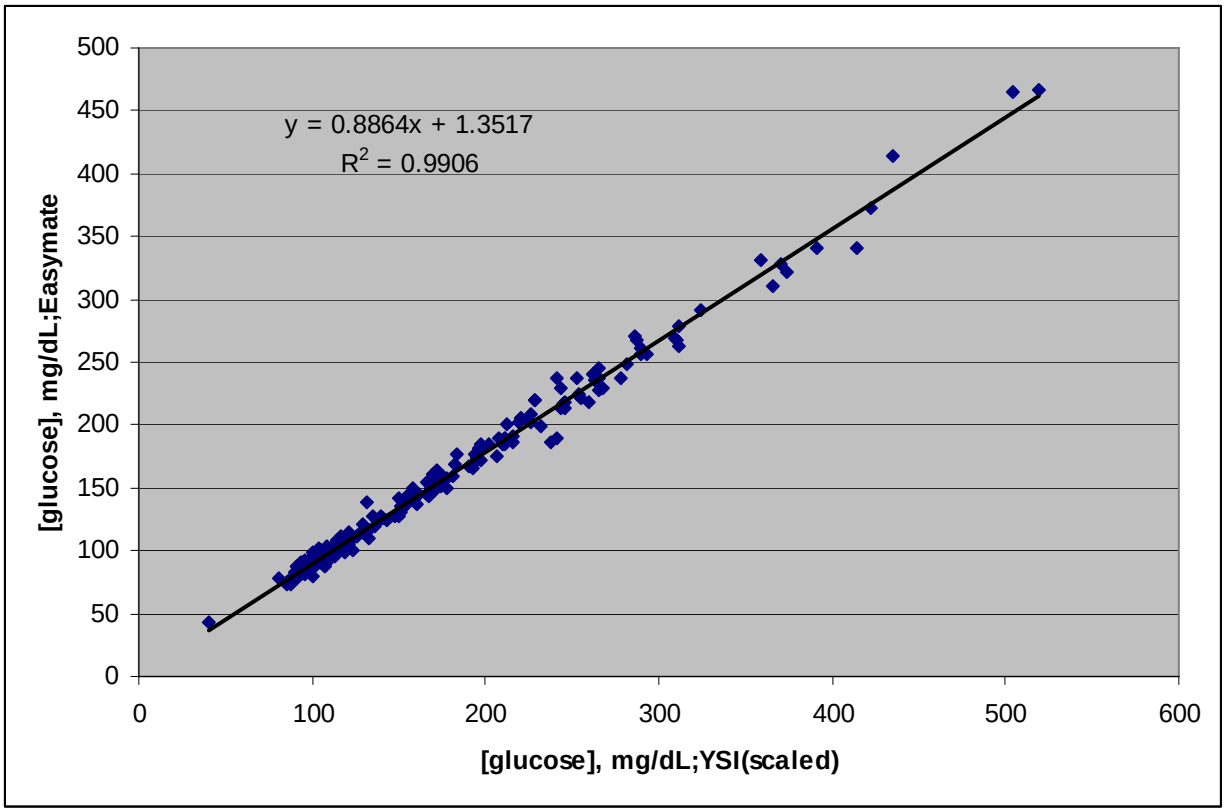
Not applicable to devices of this type.

2. Comparison studies:

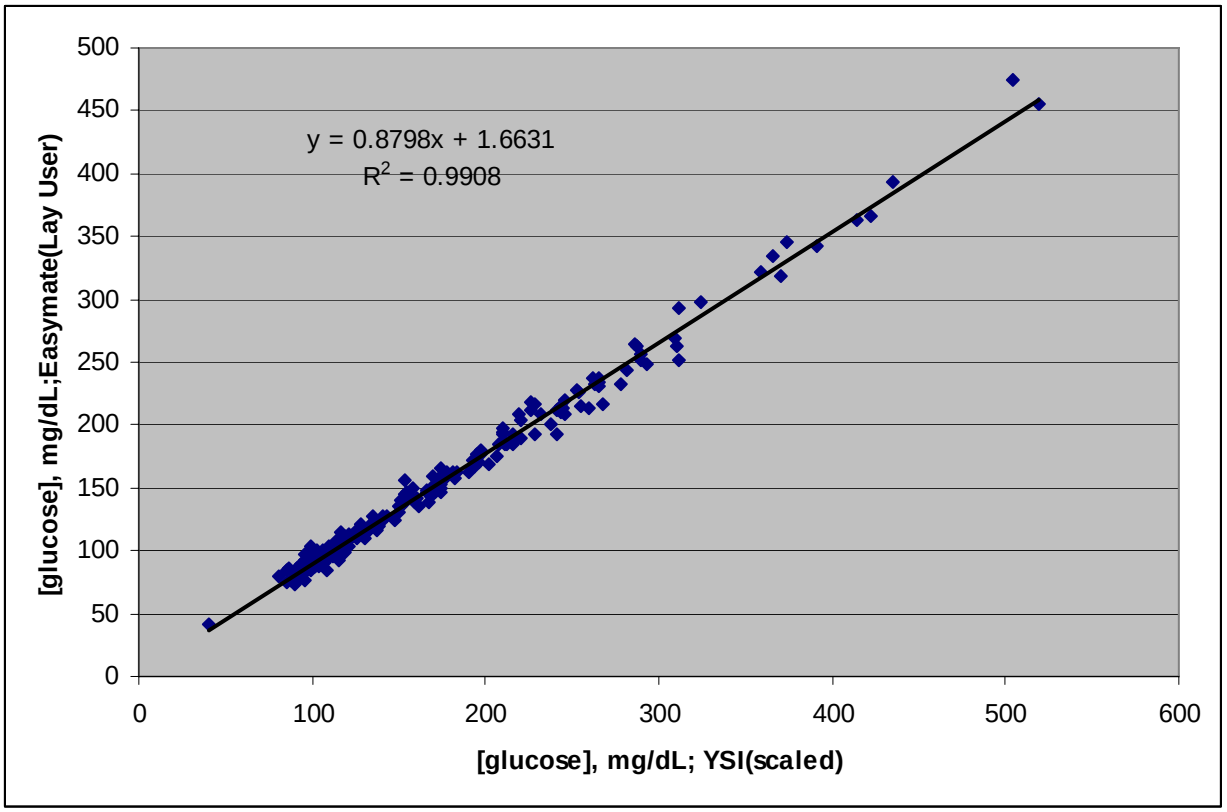
a. Method comparison with predicate device:

The company assessed the performance of their device when used by lay users. The study involved 199 participants across 3 study sites. Users were asked to read the literature accompanying the device and then perform a measurement. Subsequent to the user measurement, a trained medical technologist repeated the measurement and then drew blood samples for measurement with both YSI and Ciba-Corning Hexokinase Analyzers. Comparisons versus the YSI are presented below.

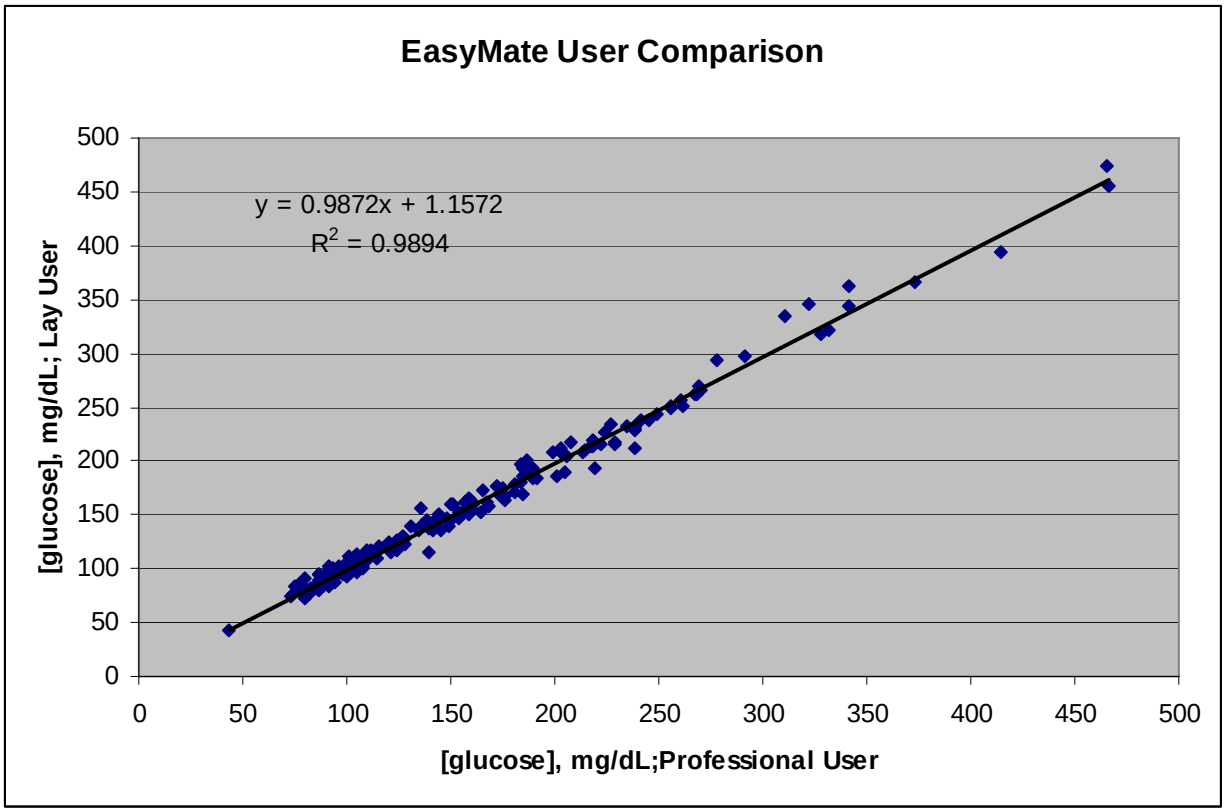
The company compared measurements made by the medical technologist against measurements made with YSI. A linear regression of this data set yielded a slope of 0.886, an intercept of 1.35 mg/dL, and an r-squared value of 0.99. Deviations from linearity were not statistically or clinically significant. All measurements made by medical technologists using this device met ISO 15197 guidelines. The following graph illustrates the relationship between the technologist measurements and that of the reference YSI method.



The company compared measurements made by lay users against measurements made with YSI. A linear regression of this data set yielded a slope of 0.880, an intercept of 1.66 mg/dL, and an r-squared value of 0.99. Deviations from linearity were not statistically or clinically significant. All measurements made by lay users using this device met ISO 15197 guidelines. The following graph illustrates the linear relationship between the lay user measurements and that of the reference YSI method.



The company also compared the measurements of the medical technologist to those made by the lay user. A linear regression of paired measurements produced a slope of 0.99, an intercept of 1.16 mg/dL, and an r-squared value of 0.989. Deviations from linearity were not statistically significant. The following graph illustrates the linear relationship between the lay user measurements and those of the medical technologist.



b. Matrix comparison:

Not applicable for this device. This device is only for use on fingerstick whole blood.

3. Clinical studies:

a. Clinical Sensitivity:

Not applicable for this device.

b. Clinical specificity:

Not applicable for this device.

c. Other clinical supportive data (when a. and b. are not applicable):

Not applicable for this device.

4. Clinical cut-off:

Not applicable for this device.

5. Expected values/Reference range:
   The company references the America Diabetes Association in the product literature when stating that normal fasting blood glucose is below 100 mg/dL.

N. Instrument Name:

EasyMate Blood Glucose Monitoring System

O. System Descriptions:

1. Modes of Operation:
   Test strips can only be used once. Users must replace the strip before taking an additional reading.

2. Software:

   FDA has reviewed applicant's Hazard Analysis and software development processes for this line of product types:

   Yes ___X__ or No _____

3. Specimen Identification:
   There is no sample identification function with this device. Samples are applied directly to the test strip as they are collected.

4. Specimen Sampling and Handling:
   This device is intended for use with fresh capillary whole blood. Since the sample is applied directly to the test strip there are no special handling or storage issues.

5. Calibration:
   Each bottle of test strips is accompanied by an electronic key which contains information necessary to customize the performance of the meter to each lot of strips. The user changes on opening a new vial of test strips. The user has the option of comparing the code number for the key against the code number printed on the vial either through the user interface of the meter or by comparing the number printed on the key. No further calibration is required of the user.

6. Quality Control:
   The company provides two levels of glucose control solutions with this device. To perform a test on a control solution, the user first inserts a check strip into the meter's receptacle for measurement strips. This check strip initiates a check of the system's electronics and prepares the meter for a measurement of a control solution. Using the check strip also prevents the meter from automatically storing the results of the measurement of the control. The user can measure control solutions without the use of

the check strip. However, these control measurements will be stored in the device's memory as if they were actual fingerstick measurements.

After replacing the check strip with a glucose test strip, the user applies a small drop of a glucose control solution. The user compares the output of this measurement to the acceptable range of measurements for each control level printed on the label of the test strip vial. If control results fall outside these ranges, the user is referred to a list of troubleshooting steps and the customer care line.

P. Other Supportive Instrument Performance Characteristics Data Not Covered In The "Performance Characteristics" Section above:

The meter supports memory for storing 70 measurements. Once stored in memory, measurement values are independent of the calibration key currently loaded in the meter. Once the memory of the device is full, additional measurements automatically overwrite the oldest stored reading. Information on software and device testing provided by the company support their performance claims for this feature.

Q. Proposed Labeling:

The labeling is sufficient and it satisfies the requirements of 21 CFR §809.10.

R. Conclusion:

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.